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ABSTRACT

The study of the movement to desegregate the public schools of this country has led to the development of numerous indices of desegregation. These measures have been used for various purposes, including assessing the effectiveness of desegregation efforts, the changes in patterns of desegregation, and the relationship between desegregation status and school district characteristics. For this study, school enrollment data for the 1978-79 school year were obtained for all public schools in Florida's 67 school districts. Eight indices of segregation or racial isolation were computed for each district. The measures were Theil's and Finizza's Measure of Racial Entropy (1967), Cisin's Segregation Index Number One (1970), Cisin's Segregation Index Number Two (1970), Farley's and Taeuber's Dissimilarity Index (1974), and Replacement Index (1974), the Index of Feasible Desegregation (Rossell and Crain, 1973), the Interracial School Contact Index (Coleman, 1975), and the Standardized Measure of Segregation (Coleman, 1975). These measures were compared across the Florida system while the size of the district and the proportion of minorities were used as independent variables. The results indicate that different indices will lead to different conclusions in identical situations. It is possible to pick an index to get a desired result. (Author/IRT)

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SOME RELATIONSHIPS OF DEMOGRAPHIC CHARACTERISTICS OF SCHOOL DISTRICTS AND INDICES OF DESEGREGATION

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Meeting of the American
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The study of the movement to desegregate the public schools of this country has led to the development of adoption of numerous indices of desegregation. These measures have been used for various purposes including the assessment of effectiveness, changes in patterns of desegregation, and the relationship of desegregation status to extant characteristics of school districts. Certain problems have been encountered with the use of the indices, however. (Dziuban and Esler, 1981, Dziuban, 1980). It has been demonstrated that the intercorrelations among a sample of those measures vary considerably and unexpectedly. Some are virtually independent of each other while others exhibit an almost perfect correspondence. A few of the measures are highly correlated with the size of the school district while others show strong relationships to the proportions of minorities found there.

It seems important that if one wishes to assess the effects of some policy decision on desegregation, the choice of an index ought not be a factor in the outcome. Similarly if one were interested in the relationship of desegregation to the demography of a district, the choice of a particular measure should have little effect of the outcome of the study. Measures which proport to assess the same construct would ideally yield identical results. Unfortunately, this is not the case so that the choice of a particular index as a criterion measure will lead to entirely different conclusions. The purpose of this paper is to construct an illustration of that fact by providing an example with real data.

Procedures

The sample for the study comprised the sixty-seven county school districts in the State of Florida. School enrollment data for the 1978-79 school year were obtained for every elementary, middle and secondary school in the state

from the management information system of the State Department of Education. The size of the districts ranged from 880 to approximately three hundred thousand. The number of pupils involved was well over a million but the effective sample size in this case was sixty-seven since each index is an aggregate number over a school districts.

Eight indices of desegregation or racial isolation were computed for each district. The measures which were obtained from the literature represent a wide range of approaches to the quantitative assessment of desegregation. They do, however, have a strong point of congruence. The architects of each have made claims for the validity of his or her measure for the assessment. In theory, at least they are closely related to each other.

The indices were:

Theil and Finizza's Measure of Racial Entropy (1967) - The concept of racial entropy appears to be borrowed from thermodynamics where it is considered a state of maximum randomization. Assumptions are made that the entropy constitutes the natural state that work must be done to overcome it. An entropic school district is one with no racially identifiable characteristics. With respect to data models, it constitutes an information theory measure and yields the reduction in uncertainty gained regarding knowledge of a student's race when his school assignment is known.

Cisin's Segregation Index Number One (1970) - Cisin conceived this index as a reflection of the degree to which the schools in a district varied from the racial proportions of the district as a whole. In this data model a perfectly desegregated school district is one in which schools in it represent the racial proportions of the district. This measure is said to be individually based in that it yields results which can be interpreted in terms of the number of pupils requiring relocation in order to comply with desegregation requirements. This is a very handy piece of information to have in these matters.

Cisin's Segregation Index Number Two (19 0) - This index is a variance accounted for type in which the total school district desegregation variance is partialed into between and within school components. These components lead to the possibility of statistical hypothesis testing. The advantages and disadvantages of this measure have been discussed by Dziuban (1980).

Farley and Taeuber's Dissimilarity Index (1974) - This measure gives an indication of the degree to which the schools of the system deviate from the ovarall racial balance in the district.

Farley and Taeuber's Replacement Index (1974) - The replacement index gives an indication of the minimum number of students requiring redistribution to achieve the same racial proportion as the district.

Index of Feasible Desegregation (Rossell and Crain 1973) - This index was developed taking into account the commonly voiced complaint that there were not enough white students to desegregate some big city schools. Consequently this index creates ratios with an arbitrary 70-30 racial balance.

Interracial School Contact (Coleman 1975) - This index is best interpreted as the proportion of a Black school child classmates who are white.

Standardized Measure of Segregation (Coleman 1975) - This index is interpreted as one minus the ratio of the proportion Blacks in the average white pupils' school to the proportion of Blacks in the district as a whole.

The formulation of the indices as well as further explanation of their properties is presented in table I. The measures described were compared across the Florida systems using the size of the district and proportion of minorities as independent measures. Initially, the partial correlation of each characteristic with the indices was computed with the effect of the other eliminated.

The results of that analysis is presented in table II. It may be observed that the zero order correlation between number of students in the

district and proportion of minorities was .06. The correlations of those variables with the indices are presented in table III. Since the two demographic characteristics were virtually independent, the partialling procedure was expected to have minimal effects on the relationships. Comparison of tables II and III will reveal this to be the case with minimal changes resulting. Table II reveals that Cisin index (r=.73) and the Standardized Measure of Segregation (r=.75) to be most highly correlated with the number of students in the district. The measure of racial entropy was virtually independent of district size (r=-.08).

Three measures, racial entropy (r=.70), the Replacement Index (r=.62) and the measure of interracial contact (r=-90) were most highly related to the proportion of minorities in the districts. Several measures achieved virtually independence with the standardized measure of segregation, yielding the lowest value (r=.15).

The linear regression of the number of students and the proportion of minorities on each of the measures was determined. The results of those analyses are presented in table IV. It may be observed that widely disparate results were achieved with the squared multiple correlation ranging from a high of .96 with the measure of interracial contact to a low of .25 with the measure of feasible desegregation.

Finally the demographic variables were trichotomized into approximate thirds and used as classification variables in hypothesis tests. This procedure was addressed to the question whether or not there were significant differences in the desegregation of the district when size of the district or proportion of minorities were considered. Districts with student populations of 880 through 3881 were classified small. Those with populations of 3992 through 15,998 were classified as medium and those with enrollments of 17,119 through 229,074 were designated as large. Districts with proportions of minorities ranging from

.02 through .154 were classified as low. Those with values ranging from .168 through .239 were designated as medium while .246 through .803 were classified as large. A one-way hypothesis test was performed on each of the measures. The results of those tests are provided in tables V and VI. From table V, it may be observed that Cisin #1, Cisin #2, the Dissimilarity Index, the Replacement Index and the Standardized Measure of Segregation would have led to that conclusion that there was a significant difference in the desegregation status of the district, when those districts were classified by size. The measure of racial entropy, the measure of feasible desegregation and the measure of interracial contact would have led to the opposite conclusion.

The results of the analysis by proportion of minorities is presented in table VI. It may be observed that the Measure of Racial Entropy, Replacement Index, Index of Feasible Desegregation and the measure of interracial contact would have led to the significant difference conclusion. Only one measure led to the same conclusion for both comparisons. The replacement index identified significant differences in both cases.

The conclusion of this paper is obvious. If one wanted information on whether there was a difference in the desegregation of districts depending on whether they were small, medium or large or whether they had low, medium or high proportion of minorities, different conclusions would be reached simply by the choice of an index. This is unacceptable with psychological testing as it should be with indices of desegregation. Important differences should not be an artifact of the particular criterion measure which was selected. Some of the indices are highly correlated with the demographics of the districts while others are independent of those measures.

One might argue that the complexity of the desegregation construct is such that reduction to a unitary concept is impractical. If, however, such is the case, then the index approach ought to be abandoned for a more comprehensive

field based method of assessment. Still further one might speculate that the nature of desegregation is situationally specific so that different indices are appropriate depending on the circumstance. Again this whole line of argument tends to detract from the utility of the index approach. If any index is ever to work, we need a clearer and constant definition on the construct.

This paper demonstrated quite simply that different indices will lead to different conclusions in identical situations. This must lead one to seriously question the use of any index in the study of school desegregation. Considering their present stage of development, it is necessary for the investigator to carefully develop his or her rationale when one or more of these measures is used in an investigation. In the absence of this, one can simply pick and choose the result they wish.

TABLE 1

Numerical Indicators of School Desegregation

Developer(s)	Index	Comments
Theil & Finizza (1967) Descriptive	Measure of Racial Entropy $\bar{E} = \sum_{i=1}^{n} p_i E_i =$ $\sum_{i=1}^{n} p_i \left[w_i \log \frac{1}{w_i} + (1 - w_i) \log \frac{1}{1 - w_i} \right]$ $\bar{E}$ = average racial entropy of all schools in the city n = total number of schools in the city p_i = proportion of students in the i^{th} school E_i = racial entropy of the student body of the i^{th} school w_i = proportion of students in the i^{th} school	This measure was based on information theory, a technique for measuring the degree of association between two qualitative or categorical variables. This index can determine not only how segregated a set of school districts is but also to what extent differences in the racial composition of the districts contribute to the segregation of the overall system (Zoloth, 1974, p. 19). Some of the advantages of the measure as noted by Zoloth (1974) included: 1) it may be extended to cases of more than two racial ethnic categories 2) it incorporates the notion of diminishing marginal payoff, i.e., the cost of additional desegregation rises with the absolute level of desegregation 3) it is easily aggregated over any unit, such as classrooms, schools or districts 4) it can be easily decomposed into between and within components such as between districts and within districts 5) it permits the analyst to verify systematically the extent to which the student body of a school is racially divided. The one major disadvantage to the measure is that it is not as easily interpreted as other indices (the dissimilarity index or Cisin's segregation index, for example).

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Pogany (cont'd)	where: C_c = objective function value with racial constraints C = objective function without racial constraints	this instance are considered as destinations, localities as origins, and commuting costs as technical coefficients. Of particular importance is that this index attempts to look at the total community (not just school districts). In view of the residential segregation which makes school desegregation difficult, considering the total community has many appealing aspects.
Coleman (1975) Descriptive	Interracial School Contact (Descriptive) $s_{bw} = \frac{\sum_k n_{kb} p_{kw}}{\sum_k n_{ki}}$ where: schools in the system are numbered 1, ...k, ...n p_{lw} = proportion of whites in the school n_{lb} = number of Blacks in the school Standardized Measure of Segregation $r_{ij} = \frac{p_j - s_{ij}}{p_j}$ where: $s_{ij} = \frac{\sum_k n_{ki} p_{kj}}{\sum_k n_{ki}}$	Coleman has developed two measures: (1) a measure of interracial school contact, and (2) a standardized measure of segregation. Index #1 denotes the proportion of white children in the same school with the average Black child (Coleman, 1975, p.7). According to Coleman, the most meaningful measure of segregation or integration between different groups is a measure expressible in terms of the experience of members of these groups... It is the proportion of the average Black child's schoolmates that are white. This is a weighted average of the proportion of white children in each school. Jackson (1975) criticized this index stating that the presence of Blacks and whites "within a given school has been shown to not necessarily result in intensive contact between the two racial groups"(p.22) He, therefore, termed Coleman's index an index of "racial proximity" not "racial contact." The second index developed by Coleman is equal to 1.0 minus the ratio of the proportion of Blacks in the average white pupil's school to the proportion of Blacks in the whole district. Coleman concludes that the measures are not without defects in that there may be no "average Black child" who has precisely the indicated proportion of whites in his school. Jackson (1975) again points to what appears to be another defect in Coleman's work. He states that "it is clear that Coleman is using the term integration to refer to what is presently more frequently called desegregation" (p. 25).

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Cisin (cont'd)		for whether or not Segregation Index #2 is a true proportion of variance; however, the utility of Segregation Index #1 which deals with the number of students who would have to be transferred from one school to another in order to equate the minority proportion among the schools is acknowledged.
Lambda Corporation (1971) (Homogeneous)	D.M. - the percentage of minority students placed in a predominantly white school. D.I. - the current D.M. divided by the maximum desegregation measure possible; the D.M. divided by the overall percentage of non-minority students in the school system.	Each minority child is seen as contributing to the Desegregation Measure (D.M.), and the "contribution" he makes is proportional to the percentage of non-minority students he finds in the school to which he is assigned. "The overall measure of desegregation level for any school system is defined to be equal to the average of these individual 'contributions' for all minority students in the system" (p. 18). Surprisingly enough, the Desegregation Index (D.I.) used in the Lambda Corporation study is mathematically identical to the Desegregation Index developed by Cisin (1970), although its derivation differs. The D.I., consequently, raises the same concerns as that voiced previously, i.e., since it deals with schools/school districts, there is no means for guarding against gerrymandering. The Lambda study points out that "...very substantial reductions in racial isolation are possible without transporting any students who could otherwise walk to school" (p. 6). Also noted is the fact that such issues as the fundamental desirability of school desegregation, the extent to which busing is justified to reduce the level of

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Lambda Corporation (cont'd)		racial isolation in a school system and the effect of racial composition on the quality of education have not been dealt with.
Rossell & Crain (1973) (Arbitray Ratio)	Index of Feasible Desegregation $D = \frac{W_I + B_I}{W_I + B_I + W_{dI} + B_{dI}}$ where: W_{dI} is the smaller of (1) (WS) or (2) $(7/3 \times B_S)$ where: B_S = number of Blacks now in schools less than 50% white B_I = number of Blacks in 50%+ white schools W_S = number of whites now in 95%+ white schools W_I = number of whites now in schools less than 95% white W_T = $W_I + W_S$ + Total no. of white pupils W_{dI} = number of additional whites who could be in schools less than 95% white B_{dI} = number of additional Blacks who could be in schools over 50% white	This index was developed taking into consideration the commonly voiced complaint that there are not enough white students to desegregate some big cities. Consequently, Rossell and Crain's index arbitrarily creates schools with 70-30 racial ratios. "Total desegregation should mean the reassignment of black students out of predominantly black schools and into white schools to create seventy-thirty racial ratios, until either (a) there are no longer any black students in predominantly black schools, or (b) there are no longer any white students in schools that are less than 30% black" (p. 19). Unfortunately Rossell and Crain have not adequately defined exactly what they mean by "feasible desegregation." Pogany, whose indices will be discussed later, contends that integration measures which are based upon prescribed majority-minority mix are distortive and depend on a preconceived notion of student welfare (p. 60), i.e., Black students benefit from attending a white school. To him, such a preconceived notion appears to be inherently racist in nature.

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Ira H. Cisin (1970) (Homogeneous)	Segregation Index #1 $SI_1 = S_1/M_1 = \Sigma n_i \lvert p_i - P \rvert / 2NP(1-P)$ Segregation Index #2 $SI_2 = S_2/M_2 = \Sigma n_i (p_i - P)^2 / NP(1-P)$ where: $S_1 = \Sigma n_i \lvert d_i \rvert$ $M_1 = 2NP(1-P)$ p_i = proportion of minority group students in the ith school P = proportion of minority group students in the district n_i = total number of students in the ith school N = total number of students in the system $d_i = p_i - P$ or the deviation of the ith school from the norm of the district $S_2 = \Sigma n_i d_i^2$ $M_2 = NP(1-P)$	Cisin perceived the notion of segregation/integration as a continuum with total isolation at one end and some defined condition of integration at the other. He stated: "... the desirable condition of perfect integration is represented by the model in which all schools in a district are similar to one another with respect to the proportion of minority group students," (p. 5). Segregation Index #1 which Cisin developed is defined as "individually-based," i.e., the final result can be interpreted in terms of the number of students needing to be shifted. Segregation Index #2 is based on a variance accountability model in which the total system or district is characterized in terms of "total variance" and partitioned into a "between schools" component and a "within schools" component. Since Cisin's indices are based on administrative units (schools/ school districts) rather than sociological units such as the city, neighborhood, etc., there is no means to control against gerrymandering and since the indices range from 0 to 1, it is difficult to determine whether they are symmetrical. Based on these two indices, Cisin consequently developed two concomitant integration indices; however, whether or not integration necessarily follows desegregation is a point of contention. The utility of statistically testing Segregation Index #2, which Cisin proposes, is another area of concern, as is the concern

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Farley & Taeuber (1974) (Homogeneous)	Index of Dissimilarity $Dwn = \frac{1}{2}\sum_i \left\lvert wi/W - ni/N \right\rvert$ Replacement Index $Dwt = \frac{1}{2}\sum \left\lvert wi/W - ti/T \right\rvert$ where: wi = number of non-Negro students in the ith school W = number of non-Negro students in the district ni = number of non-Negro students in the ith school N = number of Negro students in the district ti = number of total students in the ith school T = total number of students in the district	The Taeuber and Farley indices were developed originally (Taeuber & Taeuber, 1967) to measure residential segregation. The index of dissimilarity measures the extent to which schools in a district deviate from the city-wide student percentage Negro. The replacement index indicates the minimum percentage of non-Negro pupils that must be redistributed in order to have non-Negro pupils distributed among schools in the same manner as all pupils. The advantages of the dissimilarity index are: 1) it is easy to compute and conveniently interpreted (Zoloth, 1974, p. 28) 2) it has a straightforward, intuitive interpretation since it equals the proportion of minority (or non-minority) students who would have to be transferred in order to achieve the same racial composition in all schools (Zoloth, 1974, p. 5; Theil & Finizza, 1967, page 2 of 10). Its disadvantages include: 1) it does not give direct expression to a meaningful concept at the level of indidivuals (Request for a Proposal, Coleman, p. 13) 2) it is not policy oriented; it does not take into account what is politically and logistically feasible for that system (Rossell & Crain, 1973, p. 16) 3) its use of absolute differences makes it less suitable when one wants to aggregate schools to school districts (Theil & Finizza, 1967, page 2 of 10)

TABLE 1 (cont'd)

Developer(s)	Index	Comments
Farley & Taeuber (cont'd)		4) it also confuses the term integration with desegregation, i.e., complete integration according to Farley and Taeuber signifies every school in the district has the same racial composition as the entire district. In spite of its disadvantages, it appears to be the most popular index in use (Theil and Finizza, page 1 of 10).
Pogany (1975) (Arbitrary Ratio)	Specified Deviation from Average Racial Composition $Fn = Fn(P_1 \ldots P_k) = \Sigma N_i \lvert P_i - P_T \rvert^n$ where: P_T = percent of minority children in the community (system) P_i = percent of minority children in the i school district of the community N_i = total number of children in the i school district of the community	Pogany developed two indices in relation to the suggestion that the benefits of desegregation can be provided for minority students as long as the minority students do not exceed 40 percent of the school population. If minority children in a school exceed 40 percent, the benefits of desegregation are presumed to be lost (p. 53). The first index he termed "the specified deviation from average racial composition" and it was designed only to evaluate the acceptability of a given student assignment scheme and not to measure integration. He states the advantage of Fn is that the minority composition of the schools can be specified without placing an excessively strong requirement on the school system.
	Community Effort to Reduce Racial Isolation $\gamma = C_c \lvert C$	The second index Pogany termed γ (community effort to reduce racial isolation). "The γ ratio considers the effort to the community to desegregate regardless of its size and racial composition" (p. 60). Schools in

TABLE II

Index	# Students	Proportion Minorities
Racial Entropy	-08	70**
Cisin #1	47**	-20
Cisin #2	73**	19
Dissimilarity Index	48**	-17
Replacement Index	44**	62**
Feasible Desegregation	-20	-47**
Interracial Contact	-38**	-90**
Standardized Measure of Segregation	75**	15

** P < .05

R # students, proportion minorities = .06

Zero Order Correlations Among

the Indices and Demographic Variables

TABLE III

Index	# Students Controlling for Proportion of Minorities	Proportion of Minorities Controlling for # Students
Racial Entropy	-17	.71**
Cisin #1	.49**	-25**
Cisin #2	.74**	22**
Dissimilarity Index	50**	-23**
Replacement Index	52**	66**
Feasible Desegregation	-20	-47**
Interracial Contact	-74**	-95**
Standardized Measure of Segregation	75**	17

First Order Partial Correlations

Among the Indices and Demographic Variables

TABLE IV

Summary of the Regression Analyses

Using Number Students and Proportion of Minorities

As Independent Variables

	Mult. R	R^2	R^2 Gain	Regression Coefficient	Standardized Regression Coefficient
Racial Entropy					
Proportion Minorities	.70	.49		.70	.71
# Students	.71	.50	.01	-.42(-6) .29	-.11
Cisin #1					
# Students	.47	.22		.21(-5)	.48
Proportion Minorities	.52	.27	.05	-.27 .27	-.22
Cisin #2					
# Students	.73	.54		.17(-5)	.72
Proportion Minorities	.75	.56	.02	.10 .20(-1)	.15
Dissimilarity Index					
# Students	.48	.23		.21(-5)	.49
Proportion Minorities	.52	.27	.04	-.24 .26	-.20
Replacement Index					
Proportion Minorities	.62	.38		.23	.50
# Students	.74	.55	.17	.56(-6) -.10(-1)	.41
Feasible Desegregation					
Proportion Minorities	.47	.23		-.43	-.46
# Students	.50	.25	.03	-.57(-6)	-.17

	Mult. R	R^2	R^2 Gain	Regression Coefficient	Standardized Regression Coefficient
Interracial Contact					
Proportion Minorities	.90	.80		-.97	-.88
# Students	.96	.90	.10	-.13(-5) .96	-.33
Standardized Measure of Segregation					
# Students	.75	.57		.17(-5)	.75
Proportion Minorities	.76	.58	.01	.74(-1) .26(-1)	.11

TABLE V

Hypothesis Tests Using the Size of the Districts

As An Independent Variable

Index	(N=23) Small $\bar{X}$	S.D.	(N=23) Medium $\bar{X}$	S.D.	(N=22) Large $\bar{X}$	S.D.	F	P
Racial Entropy	.47	.14	.41	.15	.42	.10	1.3	.28
Cisin #1	.17	.14	.24	.16	.37	.14	10.6	.00
Cisin #2	.04	.05	.05	.04	.16	.11	16.1	.00
Dissimilarity Index	.15	.14	.25	.16	.37	.14	12.4	.00
Replacement Index	.03	.03	.05	.06	.08	.04	4.5	.02
Feasible Desegregation	.93	.16	.93	.12	.91	.09	.16	.85
Interracial Contact	.74	.15	.75	.16	.67	.13	2.1	.14
Standardized Measure of Segregation	.03	.04	.05	.05	.16	.11	18.5	.00

TABLE VI

Index	(N=22) Low $\bar{X}$	S.D.	(N=23) Medium $\bar{X}$	S.D.	(N=22) High $\bar{X}$	S.D.	F	P
Racial Entropy	.28	.09	.46	.05	.55	.08	77.	.00
Cisin #1	.33	.19	.23	.14	.23	.16	2.6	.07
Cisin #2	.06	.06	.07	.08	.10	.13	1.4	.25
Dissimilarity Index	.31	.19	.23	.14	.23	.16	2.1	.13
Replacement Index	.03	.02	.05	.03	.08	.08	6.9	.00
Feasible Desegregation	.99	.04	.94	.10	.84	.16	9.4	.00
Interracial Contact	.84	.07	.73	.07	.58	.16	34.2	.00
Standardized Measure of Segregation	.06	.06	.07	.08	.10	.12	1.1	.34

Hypothesis Tests Using the Proportion of

Minorities as an Independent Variable

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